

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 July 2003 (24.07.2003)

PCT

(10) International Publication Number
WO 03/061336 A1

(51) International Patent Classification⁷: **H04R 1/40**,
3/00 // 5/027

(21) International Application Number: PCT/US03/00741

(22) International Filing Date: 10 January 2003 (10.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/347,656 11 January 2002 (11.01.2002) US
10/315,502 10 December 2002 (10.12.2002) US

(71) Applicant (for all designated States except US): **MH ACOUSTICS, LLC** [US/US]; 26 Blackburn Place, Summit, NY 07901 (US).

(72) Inventors; and

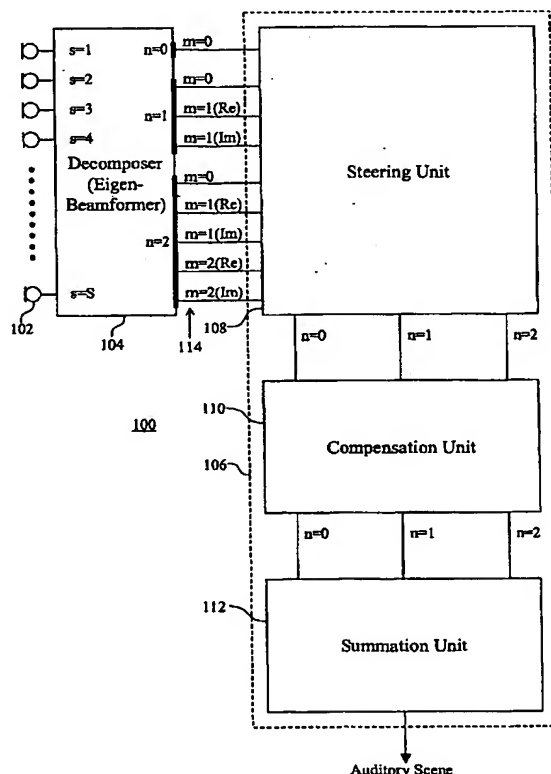
(75) Inventors/Applicants (for US only): **ELKO, Gary, W.** [US/US]; 26 Blackburn Place, Summit, NJ 07901 (US).
KUBLI, Robert, A. [US/US]; 2661 Crest Lane, Scotch Plains, NJ 07076 (US). **MEYER, Jens** [DE/US]; 46 Franklin Place, Summit, NJ 07901 (US).

(74) Agent: **MENDELSON, Steve**; Mendelsohn & Associates, P.C., Suite 715, 1515 Market Street, Philadelphia, PA 19102 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

[Continued on next page]

(54) Title: AUDIO SYSTEM BASED ON AT LEAST SECOND-ORDER EIGENBEAMS



(57) Abstract: A microphone array-based audio system that supports representations of auditory scenes using second-order (or higher) harmonic expansions based on the audio signals generated by the microphone array. In one embodiment, a plurality of audio sensors are mounted on the surface of an acoustically rigid sphere. The number and location of the audio sensors on the sphere are designed to enable the audio signals generated by those sensors to be decomposed into a set of eigenbeams having at least one eigenbeam of order two (or higher). Beamforming (e.g., steering, weighting, and summing) can then be applied to the resulting eigenbeam outputs to generate one or more channels of audio signals that can be utilized to accurately render an auditory scene. Alternative embodiments include using shapes other than spheres, using acoustically soft spheres and/or positioning audio sensors in two or more concentric patterns.

WO 03/061336 A1